Extended BASIC

Version 5

High Resolution Graphics
Level 2

RESEARCH
MACHINES

Supplementary Manual

High Resolution Graphics in BASIC

Level 2

Supplementary Manual

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Introduction

The facilities described in this document are provided in level 2 support for High Resolution Graphics (HRG) from Extended BASIC version 5. They are in addition to the standard HRG routines which are described in the 'High Resolution Graphics' manual for the 380Z or in chapters 14 and 15 of the Extended BASIC version 5 manual.

The additional features permit:-

- Dumping rectangular areas of the HRG screen to the Anadex DP 9501 printer or an Epson MX series printer (MX-80 TYPE II, MX-82, MX-100).

  The enlargement and shading patterns may be one of a predefined set or may be user-defined.

- Plotting character strings on the HRG screen in any of four orientations.

- Copying one rectangular area of the HRG screen to another.

- Reading the logical intensity of a point on the HRG screen.

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1. PRINTER SUPPORT

1.1 CALL "DUMP", X1, Y1, X2, Y2 [,D]

This copies a rectangle of the screen to the printer. The rectangle is specified by the bottom left corner (X1, Y1) and the top right corner (X2, Y2).

The colour of each point is translated into a shading pattern, the size of which can be specified by a call to PATSIZE. There are default shading patterns for each colour, and these can be changed by the user by a call to SHADING.

The fifth parameter is optional and determines the method of printing. The rectangle can be either printed accross the paper or along the paper, depending on the value of D. The value of D also determines whether the background colour on the screen will be printed as black or white. White is the default. If black is chosen then all the shading patterns will be reversed.

D=0 - Causes the x-axis to be in the direction of paper travel with the background colour printer as white. This is the default.

D=1 - Causes the x-axis to be across the width of the paper with the background colour printed as white.

D=2 - Causes the x-axis to be in the direction of the paper travel with the background colour printed as black.

D=3 - Causes the x-axis to be across the width of the paper with the background colour printed as black.

Before attempting to make a copy, you should ensure that:

1) There is a suitable printer attached to the 380Z/480Z. Suitable printers are Anadex 9501 and Epson MX series printers.

2) You have set up the printer option with BASICs PRINTER command.

3) You have selected the correct printer with the CALL"PRINTER" command. (see section 1.4)

Indications that the printer has not been set up correctly are:

1) A large number of '@' signs produced on the screen.

2) Control codes being output to the screen; on a 480Z this can be noticed by the sounding of the beeper.

3) A large number of '@' signs produced on the printer.

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1.2 CALL "PATSIZE", P, Q

This call defines a pattern size to be used for each point from the screen when dumping to the printer. If no such call is made then a default size is used - see the tables below. The values of P and Q give the size of the shading pattern where P is the x component and Q is the y component. All values of P and Q other than those in the second table below will give predefined shading patterns of blanks and the previous shading patterns will be lost. The user should then define new shading patterns using SHADING. The maximum value for both P and Q is 6.

Any call to RESOLUTION will cause a default size for the shading pattern, as follows:

RESOLUTION	Maximum Number of logical intensities	Default size of shading pattern
0,2	4	3x3
0,1	2	3x3
1,4	16	4x4
1,2	4	3x3
1,1	2	3x3
480Z only:		
2,1	2	3x3

After a call to RESOLUTION the actual shading patterns are chosen by default (see Appendix A). It is possible to define other sizes for the shading patterns which have predefined patterns, as follows:

Maximum number of logical intensities	Sizes of shading pattern which have predefined patterns
2	1x1
	2x2
	3x3 (default)
	4x4
4	3x3 (default)
	4x4
16	4x4 (default)
	6x6

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1.3 CALL "SHADING", I, VARADR(A$)

This routine defines the shading pattern for a logical intensity I. A$ contains the shading information. For example, in the case of a 4x4 shading pattern, A$ is divided up into four groups of four consecutive characters, each group corresponding to one row of the shading pattern. The left-most group is the top row in the pattern; the left-most character in each group is the left-most position in the corresponding row of the pattern.

Hence A$="0001001001001000" will give a shading pattern as follows for logical intensity I:

```
...x
..x.          (Note: "x" denotes a spot
.x..           and "." denotes a blank.)
x...
```

If the string is not the correct length for the current shading pattern size, there is an error. If any element in the string is not 0 or 1, there is an error. If I is not a possible logical intensity for the current resolution there is an error. A shading pattern is lost whenever RESOLUTION or PATSIZE is called.

1.4 CALL "PRINTER", T [,W]

The call "DUMP" command can output to either an Anadex DP9501 printer on an Epson MX series printer (MX-80 TYPE II, MX-82, MX-100). This command defines which type is being used.

The first parameter (T) defines the printer type, and the optional second parameter (W) the print mode.

T=0 - An Anadex 9501 is being used.

T=1 - An Epson MX series printer is being used.

The default is T=0 (Anadex).

When using an Anadex the second parameter has no effect.

On an Epson printer:

W=0 - Normal density bit image print

W=1 - Dual density bit image print, half the width of normal (W=0).

The default mode is normal bit image mode (W=0).

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2. HRG Characters

It is possible to output a string of characters at any point on the HRG screen. The default character set is defined on the first call to RESOLUTION after BASIC is loaded. Characters may be redefined on an 8 x 8 matrix by a call to DEFCHAR.

2.1 CALL "STPLOT", X, Y, VARADR(A$), I [,D]

This plots the string A$ starting at the point (X,Y) with logical intensity I, and in direction D.

D=0 Normal horizontal characters. This is the default value.
1 Characters sideways up the screen.
2 Characters upside down.
3 Characters sideways down the screen.

Any character in the string which is outside the range 0-127 will be 'folded' back onto the range 0-127. For example, a character with ASCII value 255 would be mapped onto 127.

A direction outside the range 0-3 is 'folded' back onto the range 0-3. D is an optional parameter - if not supplied it defaults to zero.

2.2 CALL "CHARSIZE", XE, YE

This defines the magnification of the characters to be plotted by STPLOT.

XE=The magnification in the X-direction.
YE=The magnification in the Y-direction.

XE and YE should both be in the range 1-255.

A value of zero will produce the error message 'Illegal arg'

The values of XE and YE will be reset to 1 on any call to RESOLUTION.

2.3 CALL "DEFCHAR", C, B1, B2, B3, B4, B5, B6, B7, B8

This allows the user to define characters for use by STPLOT. The parameters are:

C= The ASCII value of the character to be defined.

B1 to B8= The bytes making up the character.

The value of C should be in the range 0 to 127.

B1 refers to the top row of the character, B2 to the second, B3 to the third, and so on.

The values of B1, B2, ..., B8 are treated as binary numbers. If the ith bit of B1 is a 1, then the ith column of the top line is a dot; if the ith bit is a 0, then the ith column is a blank, and similarly for B2, B3, ..., B8. The least significant binary digit corresponds to

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the rightmost column.

EXAMPLES (1 and 2 are predefined, 3 is not)

1. CAPITAL 'A'

	DECIMAL	BINARY	CHARACTER
B1	24	00011000	...XX...
B2	36	00100100	..X..X..
B3	66	01000010	.X....X.
B4	66	01000010	.X....X.
B5	126	01111110	.XXXXXX.
B6	66	01000010	.X....X.
B7	66	01000010	.X....X.
B8	66	01000010	.X....X.

2. DOLLAR SIGN

B1	0	00000000	....
B2	8	00001000	....X...
B3	63	00111111	..XXXXXX
B4	72	01001000	.X..X...
B5	62	00111110	..XXXXX.
B6	9	00001001	....X..X
B7	126	01111110	.XXXXXX.
B8	8	00001000	....X...

3. INTEGRAL SIGN

B1	3	00000011	XX
B2	4	00000100	.....X..
B3	8	00001000	....X...
B4	8	00001000	....X...
B5	8	00001000	....X...
B6	8	00001000	....X...
B7	16	00010000	...X....
B8	96	01100000	.XX.....

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3. MOVING BLOCKS

It is possible to copy a rectangle from one area of the screen to another.

3.1 CALL "COPY", X1, Y1, X2, Y2, XD, YD

This moves a copy of the rectangle defined by lower left corner (X1,Y1) and upper right corner (X2,Y2). The destination of the copy is defined by the lower left corner (XD,YD).

The copy is made on a line by line basis in order to save space. If any of the coordinates X1, Y1, X2 or Y2 are outside the area of the screen for the current resolution, they will be adjusted so that any value outside is placed in range. For example: if the command CALL "COPY", 0, 0, 500, 300 entered, when in high resolution, the area of the screen that will be copied is 0, 0, 319, 191.

4. READING A POINT

It is possible to read back the logical intensity of the screen from a given coordinate in a similar manner to the POINTS low resolution graphics function of BASIC.

4.1 CALL "RDOUT", X, Y, VARADR(V)

This reads the logical intensity at the point given by X and Y and will return it in the variable V.

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Appendix A

Default Shading Patterns

1. 2 Logical Intensities

   In this case, colour 1 will be no dots. Colour 0 will be all dots printed in the matrix.

2. 4 Logical Intensities

3x3	Intensity	0	1	2	3
		...	.x.	xxx	xxx
		...	x.x	x.x	xxx
		...	.x.	xxx	xxx

4x4	Intensity	0	1	2	3
		....	.xx.	xxxx	xxxx
		....	x..x	x..x	xxxx
		....	x..x	x..x	xxxx
		....	.xx.	xxxx	xxxx

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3. 16 Logical Intensities

4x4 Intensity

0	1	2	3
....	...x	....	x..x
....	....	x..x	....
....	....	..x.	....
....	x...	....	x..x

4	5	6	7
.xx.	x..x	xx..	...x
x...	.x..	...x	x..x
x..x	..x.	x...	x..x
....	x..x	x.xx	.xx.

8	9	10	11
x.xx	xx.x	xx.x	xxxx
...x	x..x	x.xx	x..x
.x..	x..x	.xx.	x..x
xxxx	x.xx	xx.x	xxxx

12	13	14	15
xxxx	xxxx	xxxx	xxxx
x..x	xx.x	x.xx	xxxx
xx.x	x.xx	xxxx	xxxx
xxxx	xxxx	xxxx	xxxx

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6x6 Intensity

0

```
......
......
......
......
......
......
```

1

```
......
.x..x.
......
......
.x..x.
......
```

2

```
x....x
......
...x..
..x...
......
x....x
```

3

```
.x..x.
x....x
......
......
x....x
.x..x.
```

4

```
.x..x.
xx..xx
......
......
xx..xx
.x..x.
```

5

```
.xx.x.
x....x
x....x
x....x
x....x
.xxxx.
```

6

```
.xxxx.
x....x
.x..x.
.x..x.
.xxxx.
x....x
```

7

```
x.x.x.
.x.x.x
.x.x.x
x.x.x.
.x.x.x
x.x.x.
```

8

```
xxxxxx
x....x
x....x
x....x
x....x
xxxxxx
```

9

```
xxxxxx
x....x
x.xx.x
x.xx.x
x....x
xxxxxx
```

10

```
xx..xx
x.xx.x
.xxxxx
xxxxx.
x.xx.x
xx..xx
```

11

```
xxxxxx
xx..xx
x.xx.x
x.xx.x
xx..xx
xxxxxx
```

12

```
xxxxxx
x.xx.x
xx.xxx
xxx.xx
x.xx.x
xxxxxx
```

13

```
xxxxxx
xxxxxx
xx..xx
xx..xx
xxxxxx
xxxxxx
```

14

```
xxxxxx
x.xxxx
xxxxxx
xxxxxx
xxxx.x
xxxxxx
```

15

```
xxxxxx
xxxxxx
xxxxxx
xxxxxx
xxxxxx
xxxxxx
```

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Appendix B

Additional Error Messages to HRG level 1

1) "Illegal shading pattern"

A shading pattern should be made up of 0s and 1s only. If a different character is found in the defined shading pattern then this error message is given.

2) "Invalid pattern length"

The length of the shading pattern presented must correspond to the pattern size declared in the call to PATSIZE. If you are using a 3x3 pattern size then 9 digits should be present in the shading pattern. If the length of the pattern presented is not correct for the current pattern size then this error message is given.

3) "RESOLUTION not CALLed"

Certain CALLs cannot be executed unless RESOLUTION has been called at least once since BASIC was loaded. These are:

CHARSIZE
COPY
DUMP
OFFSET
PATSIZE
SHADING
STPLOT

The reason for this is that the HRG characters are held in an area of memory which is used by these calls as workspace. Upon a call to RESOLUTION the characters are removed to another area of memory and the space is available to be used.

Of course you will discover that the other commands do not work properly until RESOLUTION has been CALLed.

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Appendix C

Example Programs

1. EXCOPY

This simple program is designed to show the speed and ease of use of COPY.

```
10   REM EXCOPY
20   PUT 12
30   CALL "RESOLUTION", 0, 2
40   CALL "FILL", 0, 0, 40, 40, 3
50   CALL "FILL", 8 ,8 ,32, 32, 0
60   CALL "FILL"17, 17, 36, 26, 2
70   FOR J=30 TO 150 STEP 30
80   CALL "COPY", J-30, J-30, J+10, J+10, J, J
90   NEXT J
100  END
```

2.SINE

This program plots and labels a sine graph, showing some of the features of STPLOT. It then prints the graph on the printer, with a white backgrund, the x-axis running across the width of the paper, and with a pattern size of 2x2, using the default shadings.

```
10   REM SINE: shows a use of STPLOT, and demonstrates DUMP.
20   PUT 12
30   LET X$="x" : LET Y$="y"
40   LET A$="↑" : LET P$=CHR$(21)
50   REM P$ is the HRG character pi.
60   LET P2$="2"+P$ : LET P3$="3"+P$
70   LET I$="1" : LET I1$="-1"
80   CALL "RESOLUTION",0,1
90   CALL "OFFSET", -8, -96
100  REM plot sine wave.
110  LET A=16*ATN(1)/318
120  FOR X=0 TO 318
130  LET Y=50*SIN(A*X)
140  CALL "PLOT", X, Y, 1
150  NEXT X
160  REM plot and label axes.
170  CALL "PLOT", 0, -96, 0
180  CALL "LINE", 0, 96, 1
190  CALL "STPLOT", -4, 88, VARADR(A$), 1
200  CALL "STPLOT", 8, 88, VARADR(Y$), 1
210  CALL "PLOT", 0, 0, 0
220  CALL "LINE", 311, 0, 1
230  REM line 240 plots '?' on its side.
240  CALL "STPLOT", 303, 4, VARADR(A$), 1, 3
250  CALL "STPLOT", 302, 8, VARADR(X$), 1
260  REM draw a heading and mark points on each axis.
270  LET B$="Graph of y=sin x"
280  CALL "STPLOT", 30, 70, VARADR(B$), 1
290  CALL "PLOT", -2, 49, 0
300  CALL "LINE", 2, 49, 1
310  CALL "STPLOT", 5, 45, VARADR(I$), 1
320  CALL "PLOT", -2, -50, 0
330  CALL "LINE", 2, -50, 1
340  CALL "STPLOT", 5, -53, VARADR(I1$), 1
350  CALL "STPLOT", 79, 4, VARADR(P$), 1
360  CALL "STPLOT", 2*79-16, 4, VARADR(P2$), 1
370  CALL "STPLOT", 3*79, 4, VARADR(P3$), 1
380  REM Set the shading pattern size to be 2x2
390  CALL "PATSIZE", 2, 2
400  REM Dump the screen to the printer.
405  REM Assumes correct type has been set up.
410  INPUT "Press <RETURN> when ready to dump picture",A$
420  CALL "DUMP", -8, -96, 310, 95, 1
430  END
```

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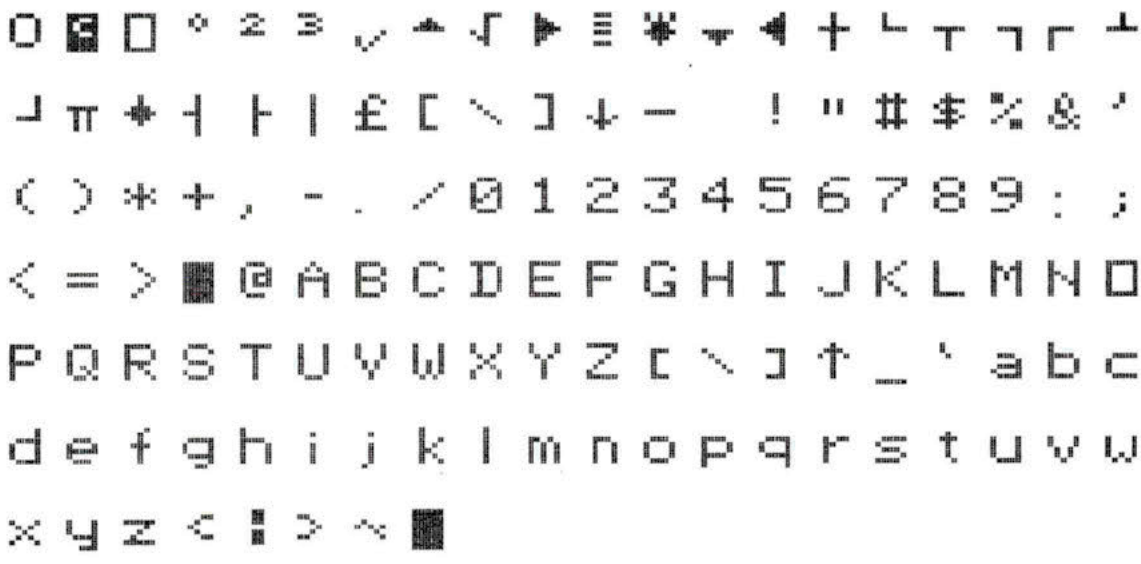
3. CHRSET

This program displays the HRG character set on the screen. It then dumps them on the printer, with pattern size 2x2, with the x-axis in the direction of paper travel. The shading patterns have to be defined, as there are no defaults for size 2x2 when working in HR2.

```
10   REM CHRSET: displays HRG characters, and dumps them on the PRINTER
20   CALL "RESOLUTION",0,2
30   FOR I=0 TO 3
40   FOR J=1 TO 39
50   LET A$=CHR$(39*I+J)
60   IF 39*I+J=128 THEN 100
70   CALL "STPLOT", (J-1)*8,96-24*I, VARADR(A$),3
80   NEXT J
90   NEXT I
100  REM Define pattern size as 2x2
110  CALL "PATSIZE", 2, 2
120  REM Define shading patterns for intensities 0 and 3
130  LET A$="0000"
140  REM Logical intensity 0 is shaded as all blanks
150  CALL "SHADING", 0, VARADR(A$)
160  LET A$="1111"
170  REM Logical intensity 3 is shaded as all spots
180  CALL "SHADING", 3, VARADR(A$)
190  INPUT "Press <RETURN> to dump picture", A$
200  CALL "DUMP", 0, 0, 318, 191
210  END
```

Here is what the character set looks like:



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